CONSTRUCTION PERMIT APPLICATION
RELINE OF NO. 13 BLAST FURNACE
U.S. STEEL – GARY WORKS
PLANT ID NO. 089-00121

APPENDIX 10-1

Construction Permit Application Forms

convert CO to CO_2 at efficiencies in excess of 98%. Table 8-2 lists CO control options identified from EPA's BACT/LAER Clearinghouse from iron and steel making permits.

8.5.2.3 Selection of BACT

At Gary Works all BFG produced from iron making is burned in air either beneficially as a fuel or wasted at the BGF flare stacks. Considering the above, the current operations and the resulting CO emissions should be considered as BACT.

8.6 BACT for Sulfur Dioxide

8.6.1 Blast Furnace Casthouse and Slag Pit

8.6.1.1 Formation and Release Mechanisms

The raw materials that are charged into No. 13 Blast Furnace contain sulfur as intrinsic sulfur compounds. The largest contributors to the total sulfur input to the furnace are coal, coke and BOP slag. The molten iron produced in the blast furnace must have a limited sulfur content. Sulfur is removed from molten iron to meet specifications by introducing fluxing agents (e.g., calcium lime and dolometic lime) which react with sulfur and other undesired elements in molten iron to form a slag which floats on top of the molten metal. Not all of the sulfur is removed from the hot metal in the blast furnace. Some very small amount of the elemental sulfur in the molten iron is burned at the surface of the molten iron when it is cast from the furnace to form SO_2.

The sulfur in molten blast furnace slag is in the forms of sulfates, sulfites and sulfides. Some of the sulfur in slag is in the form of gaseous hydrogen sulfide (H_2S) described in the molten slag solution. When the molten slag exits the furnace, the dissolved H_2S is liberated from the solution and some of the H_2S burns at the interface between the molten slag and air to form SO_2.

The SO_2 emitted at the casthouse, emanates from the taphole, the iron trough, the slag runners and the iron runners. These emission points are mostly controlled for particulate matter by the casthouse fume collection and control system. Therefore, most of the SO_2 formed and emitted at the casthouse is captured and emitted through the PM_{10} emission control system baghouse stack.

The SO_2 emitted at the slag pit emanates from the slag fall from the casthouse to the slag pit and from the molten slag prior to solidifcation.

8.6.1.2 Listing of Technologies

Discussions with air pollution control equipment vendors revealed three "end-of-pipe" technologies for SO_2 control for possible consideration for application to the blast furnace casthouse.

1. Wet Scrubber.
2. Dry Sorbent Reactor Process.
3. Spray Dryer Process.

Wet Scrubber

In the wet scrubber system, the waste gas containing SO_2 is passed through the absorber section where it makes contact with an acid absorbent/neutralizing solution or slurry. The acidic SO_2 is neutralized/absorbed to form sulfate salt which is removed as a sludge/slurry, dewatered and disposed of.

Dry Sorbent Reactor Process

In the dry sorbent reactor process, the waste gas is first passed through a large reaction chamber which is located upstream of a fabric filter baghouse. A dry absorbent is injected into the gas stream before it enters the reaction chamber. The dry absorbent absorbs/neutralizes acid gas (SO_2) onto the solid absorbent. The gas stream with the absorbent is passed from the reaction chamber into the fabric filter baghouse. The particulate matter in the gas stream and the dry absorbent material forms a cake on the filter fabric. As the gas passes through the cake on the fabric filter, additional absorption/neutralization of SO_2 takes place.

Spray Dryer Process

In the spray dryer process, an alkaline slurry or solution is atomized into the waste gas stream in a spray dryer absorber. The atomized droplets absorb SO_2 and the heat in the waste gas evaporates the water from the slurry or solution droplets to form a suspension of solid absorbent media in the gas stream. The solids and particulate matter form a cake on the fabric filter in the baghouse. As the gas passes through the cake, additional absorption/neutralization of SO_2 takes place.

8.6.1.3 Evaluation of Technologies

Wet Scrubber

The application of a wet scrubber system at No. 13 Blast Furnace Casthouse is precluded by wastewater discharge permitting considerations. The Gary Works National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit has been stayed for an unknown period of time. This means that no new sources of wastewater discharges can be permitted until a new NPDES Permit is issued.

Dry Sorbent Reactor Process

The No. 13 Blast Furnace Casthouse Emissions Control System has a mass cooler installed upstream of the baghouse. This cooler consists of a series of heavy steel plates suspended at a specified spacing in the hot waste gas stream exhausted from the casthouse. When casting operations are occurring, heat is transferred by convection from the gas to the plates thus reducing the temperature of the gas to levels that will not damage the bags in the baghouse. When casting operations are not occurring, heat is transferred by convection and radiation from the plates to the surroundings which lowers the temperature of the plates to receive heat again. The mass cooler is a critical part of the emissions control system.

The designer/builder of the emissions control system cautions that a sorbent injection system should not be installed upstream of the mass cooler. The injection of the material at that location would result in the plugging of the spaces between the plates; coating and corroding the plates; and significantly reducing the capacity for heat transfer. This requires the injection of absorbent downstream of the mass cooler and upstream of the existing baghouse. The area between the mass cooler and the baghouse is severely restricted with respect to space. The dry sorbent reactor process would require a cylindrical reaction chamber (tower) 22 feet in diameter and 120 feet high. There is not sufficient space to install the reactor. Therefore, the application of the dry sorbent process at the No. 13 Blast Furnace Casthouse is considered to be technically infeasible.

Spray Dryer Process

The technical infeasibility of the dry sorbent reactor process and the preclusion of a wet scrubber, leaves the spray dryer process for consideration. Again, the absorbent must be directly injected into the duct between the mass cooler and the baghouse. This is a short run of duct with a low gas residence time for the absorbing/neutralizing reaction to occur. In addition, the gas temperature downstream of the cooler is approximately 250°F, which is too low for efficient SO_2 removal, and the concentrations of SO_2 in the gas are low compared to other locations where the technology is applied.

The combination of the above factors will result in very low SO_2 removal efficiency, estimated to be no higher than 40 percent.

The rough budgetary capital cost estimate for the installation of the lime handling system is $500,000. The system would require approximately one ton of lime injectant per hour at a cost of approximately $100 per ton of lime. The additional lime will increase the amount of baghouse dust that must be disposed of at a hazardous waste landfill. Table 8-3 presents a budgetary estimate of annualized cost for a spray dryer process with respect to expected SO_2 abatement. As shown on the table, the abatement cost exceeds $10,000 per ton of SO_2 abated. Considering that the results of the Ambient Air Quality Analysis demonstrate compliance with the NAAQS for SO_2 without casthouse SO_2 emissions control at No. 13 Blast Furnace, this abatement cost is excessive.

8.6.1.4 Selection of BACT

There are no blast furnaces in the United States with SO_2 controls for casthouses and slag pits. The only identified potentially applicable technology (Spray Dryer Process)

TABLE 8-3
U.S. STEEL - GARY WORKS
NO. 13 BLAST FURNACE RELINE PROJECT
CONSTRUCTION PERMIT APPLICATION

Spray Dryer Absorption Process
Estimated Cost per Ton of SO_2 Abated

(Estimated Capital Cost is $500,000)

Annualized Capital Cost – 15 yrs @4%	$53,333
Cost of Lime Injectant	$876,000
Cost of Additional Electric Power	$49,336
Cost of Additional Baghouse Dust Disposal @ $125/Ton	$1,095,000
Maintenance Cost 5% of Capital	$25,000
Total Annualized Cost	$2,098,670
Maximum Future SO_2 Emissions Tons/Yr	504
Estimated Control Efficiency	40.0%
Estimated Tons of SO_2 Abated	201
Cost per Ton of SO_2 Abated	$10,441